

Exhibit 11 to Complaint

Intellectual Ventures I LLC and Intellectual Ventures II LLC

**Example American Count V Systems and Services
U.S. Patent No. 10,103,845 (“the ’845 Patent”)**

The Accused Systems and Services include without limitation American systems and services that provide Wi-Fi Access Points that support at least IEEE 802.11n and/or 802.11ac; all past, current, and future systems and services that operate in the same or substantially similar manner as the specifically identified systems and services; and all past, current, and future American systems and services that have the same or substantially similar features as the specifically identified systems and services (“Example American Count V Systems and Services” or “American Systems and Services”).¹

On information and belief, the American Systems and Services provide Wi-Fi Access Points that enable Internet connectivity on its airplanes.

American continues to make its high-speed inflight Wi-Fi more accessible and easier to use, whether customers connect to work or browse the internet. From introducing a new way for AAdvantage® members to use their miles to consistently improving the inflight connectivity and entertainment experience, customers can look forward to making the most of their time onboard.

Source: <https://news.aa.com/news/news-details/2024/American-Airlines-enhances-inflight-connectivity-and-entertainment-will-introduce-AAdvantage-redemption-MKG-OB-03/default.aspx>.²

¹ Plaintiffs do not accuse licensed systems and services, and to the extent such systems and services has a license to Plaintiffs’ patents that covers Defendant’s activities. Plaintiffs will provide relevant license agreements for Wi-Fi Access Points in discovery, to the extent any such license agreements have not already been produced. To the extent any of these licenses are relevant to Defendant’s activities, Plaintiffs will meet and confer with Defendant about the impact of such license(s). Once a protective order is entered into the case, Plaintiffs will provide further details.

² Unless otherwise noted, all sources cited in this document were publicly accessible as of the date of the Complaint.

American Airlines Wi-Fi Subscription Plan

Live Chat

Air: Inflight Wi-Fi portal choose Contact Us
Ground: <https://support.aainflight.com>

Phone: 844-994-4646

Email: subscription.wifi@aa.com

The inflight Wi-Fi portal will display 'Connected by Gogo'

Your credit card statement charges will appear as 'AA WIFI'

Intelsat**

Live Chat

Air: Inflight Wi-Fi portal choose Contact Us
Ground: <https://care.inflightinternet.com>

Phone: 877-350-0038

Email: support@wifionboard.com

The inflight Wi-Fi portal will display 'Wi-Fi Onboard (provided by Intelsat)'

Your credit card statement charges will appear as 'WIFIONBOARD'

Panasonic

Phone: 866-924-3715

Email: aawifihelp@panasonic.aero

The inflight Wi-Fi portal will display "Service provided by Panasonic"

Your credit card statement charges will appear as "AA-WIFI BY PANASONIC"

Source: <https://entertainment.aa.com/en/wi-fi-packages>.

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
[1.pre]. A method of operation of a transceiver in a plurality of modes including at least a first mode and a second mode, the method comprising:	<p>To the extent this preamble is limiting, on information and belief, the American Count V Systems and Services practice a method of operation of a transceiver in a plurality of modes including at least a first mode and a second mode.</p> <p>For example, American airplanes are equipped with at least Gogo/Intelsat/Panasonic devices that provide Wi-Fi connectivity to customers. On information and belief, Wi-Fi connectivity is provided with a dual-band router (transceiver).</p> <div> <div> <p>American Airlines Wi-Fi Subscription Plan</p> <p>Live Chat Air: Inflight Wi-Fi portal choose Contact Us Ground: https://support.aainflight.com Phone: 844-994-4646 Email: subscription.wifi@aa.com The inflight Wi-Fi portal will display 'Connected by Gogo' Your credit card statement charges will appear as 'AA WIFI'</p> </div> <div> <p>Intelsat**</p> <p>Live Chat Air: Inflight Wi-Fi portal choose Contact Us Ground: https://care.inflightinternet.com Phone: 877-350-0038 Email: support@wifionboard.com The inflight Wi-Fi portal will display 'Wi-Fi Onboard (provided by Intelsat)' Your credit card statement charges will appear as 'WIFIONBOARD'</p> </div> <div> <p>Panasonic</p> <p>Phone: 866-924-3715 Email: aawifihelp@panasonic.aero The inflight Wi-Fi portal will display 'Service provided by Panasonic' Your credit card statement charges will appear as 'AA-WIFI BY PANASONIC'</p> </div> </div> <p>Source: https://entertainment.aa.com/en/wi-fi-packages.</p>

U.S. Patent No. 10,103,845 (Claim 1)			
Claim 1	Example American Count V Systems and Services		
	<p>SPECIFICATIONS</p> <p>ANTENNA TYPE Electronic Phased Array</p> <p>FIELD OF VIEW 140° (Mount at 8° Angle for Rainfall)</p> <p>ORIENTATION Fixed</p> <p>DISH WEIGHT 5.9 kg / 13 lbs without Cable 6.7 kg / 15 lbs with 8 m / 26.2 ft Cable</p> <p>DIMENSIONS (L×W×H): 575x511x41 mm / 22.6" x 20.1" x 1.6"</p> <p>ENVIRONMENTAL RATING IP56</p> <p>OPERATIONAL TEMPERATURE -30°C to 50°C (-22°F to 122°F)</p> <p>WIND SPEED Survivable: 280 kph+ (174 mph+)</p> <p>SNOW MELT CAPABILITY Up to 75 mm / hour (3 in / hour)</p> <p>POWER CONSUMPTION Average: 110-150 W</p> <p>Wi-Fi Dual Band Wi-Fi 5 - 3x3 MIMO</p> <p>USER LAN RJ45 Cable</p> <p>ROUTER SECURITY WPA2</p> <p>ROUTER RANGE Up to 185 m (2000 ft) Varies on placement, interference, and materials</p> <p>POWER SPECIFICATIONS 100-240V - 6.3A 50 - 60 Hz</p> <p>USER LAN RJ45 Cable</p> <p>ADDITIONAL ACCESSORIES AC - Cable Wi-Fi Router Ethernet Cable - 30m Router Cable - 30m 8m Flat High Performance (FHP) Cable 25m Flat High Performance (FHP) Cable Power Supply Ethernet Adapter Mesh Wi-Fi Router Cable Routing Kit Mason Routing Kit Wedge Mount Kit FHP Pipe Adapter Ruggedized Terminal Case</p> <p>Source: https://www.intelsat.com/wp-content/uploads/2023/08/LEO-Terminal-Sheet.pdf.</p> <p>Panasonic Panasonic Avionics Corporation 26200 Enterprise Way Lake Forest, CA 92630 USA</p> <p>PRODUCT DESCRIPTION FOR Enhanced Cell Modem</p> <p>PART NUMBER: RD-AA8190-01</p>		

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>1.0 GENERAL</p> <p>1.1 Purpose</p> <p>The Enhanced Cell Modem (eCM) is a component of the GCS/eXConnect system designed to provide cellular and wireless data bridge from aircraft to ground network server for gatelink application. The eCM communicates with other head-end equipment through dual ports copper gigabit Ethernet and serves as cellular-to-wired network switch, routing media content, application software and service data.</p> <p>➤ The eCM supports the following functions:</p> <ul style="list-style-type: none"> • Offloads cached credit card transaction data. • Offloads BITE data. • Loads media content. • Loads and monitors Digital Right Management (DRM) key. <p>2.6 Wireless LAN Interface</p> <p>➤ Frame Format & Protocol:</p> <ul style="list-style-type: none"> • IEEE 802.11a/b/g/n/ac. <p>➤ Topology:</p> <ul style="list-style-type: none"> • Peer-to-access point (infrastructure). <p>➤ Data Rate:</p> <ul style="list-style-type: none"> • 11 Mbits/s (802.11b). • 54 Mbits/s (802.11a/g). • 450 Mbits/s (802.11n) with 3x3 MIMO antenna. • 1.3 Gbits/s (802.11ac) with 3x3 MIMO antenna.

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>➤ Receiver Sensitivity:</p> <ul style="list-style-type: none"> 2.4 GHz: -86 dBm (802.11b/11Mbps), -63 dBm (802.11n/VHT40/MCS9). 5 GHz: -74 dBm (802.11a/54Mbps), -61 dBm (802.11ac/VHT80/MCS9). <p>➤ Transmitter Power:</p> <ul style="list-style-type: none"> 2.4 GHz: 18 dBm (802.11b/11Mbps), 8.2 dBm (802.11ac/VHT40/MCS9). 5 GHz: 18 dBm (802.11a/6 Mbps), 10.2 dBm (802.11ac/VHT80/MCS9). <p>Source: https://fcc.report/FCC-ID/U6YRDAA8190/5344017.pdf.</p> <p>For the 802.11-2016 standard, an HT AP can operate in a plurality of modes including 20 MHz and 40 MHz depending on its channel width value in Supported Channel Width Set subfield of the HT capabilities. Further, a VHT AP can also operate in other plurality of modes, such as 40 MHz and 80 MHz and 20 MHz and 80 MHz, as required by 802.11n and/or 802.11ac.</p> <p>11.16.2 Basic 20/40 MHz BSS functionality</p> <p>An HT AP declares its channel width capability (20 MHz only or 20/40 MHz) in the Supported Channel Width Set subfield of the HT Capabilities element.</p> <p>Source: IEEE 802.11-2016 at 1747.</p> <p>3.2 Definitions specific to IEEE Std 802.11</p> <p>40-MHz-capable (40MC) high-throughput (HT) access point (AP): An HT AP that included a value of 1 in the Supported Channel Width Set subfield (indicating its capability to operate on a 40 MHz channel) of its most recent transmission of a frame containing an HT Capabilities element.</p> <p>Source: IEEE 802.11-2016 at 144.</p>

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>19. High-throughput (HT) PHY specification</p> <p>19.1 Introduction</p> <p>19.1.1 Introduction to the HT PHY</p> <p>The HT PHY is based on the OFDM PHY defined in Clause 17, with extensibility up to four spatial streams, operating in 20 MHz bandwidth. Additionally, transmission using one to four spatial streams is defined for operation in 40 MHz bandwidth. These features are capable of supporting data rates up to 600 Mb/s (four spatial streams, 40 MHz bandwidth).</p> <p>Source: IEEE 802.11-2016 at 2334.</p> <p>19.3.4 Overview of the PPDU encoding process</p> <p>o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH_BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of non-HT formats), insert four subcarriers as pilots into positions -21, -7, 7, and 21. The total number of the subcarriers, N_{ST}, is 56. For 40 MHz operation (with the exception of MCS 32 and non-HT duplicate format), insert six subcarriers as pilots into positions -53, -25, -11, 11, 25, and 53, resulting in a total of $N_{ST} = 114$ subcarriers. See 19.3.11.11.5 for pilot locations when using MCS 32 and 19.3.11.12 for pilot locations when using non-HT duplicate format. The pilots are modulated using a pseudorandom cover sequence. Refer to 19.3.11.10 for details. For 40 MHz operation, apply a +90° phase shift to the complex value in each OFDM subcarrier with an index greater than 0, as described in 19.3.11.11.4, 19.3.11.11.5, and 19.3.11.12.</p> <p>Source: IEEE 802.11-2016 at 2353.</p>

The main PHY features in a VHT STA that are not present in an HT STA are the following:

- Mandatory support for 40 MHz and 80 MHz channel widths

Source: IEEE 802.11-2016 at 197.

21.1.1 Introduction to the VHT PHY

Clause 21 specifies the PHY entity for a very high throughput (VHT) orthogonal frequency division multiplexing (OFDM) system.

In addition to the requirements in Clause 21, a VHT STA shall be capable of transmitting and receiving PPDU's that are compliant with the mandatory PHY specifications defined in Clause 19.

The VHT PHY is based on the HT PHY defined in Clause 19, which in turn is based on the OFDM PHY defined in Clause 17. The VHT PHY extends the maximum number of space-time streams supported to eight and provides support for downlink multi-user (MU) transmissions. A downlink MU transmission supports up to four users with up to four space-time streams per user with the total number of space-time streams not exceeding eight.

NOTE—MU transmission is different from VHT SU group addressed transmission.

The VHT PHY provides support for 20 MHz, 40 MHz, 80 MHz, and 160 MHz contiguous channel widths and support for 80+80 MHz noncontiguous channel width.

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Claim 1	Example American Count V Systems and Services
	<p>A VHT STA shall support the following features:</p> <ul style="list-style-type: none"> — Non-HT and non-HT duplicate formats (transmit and receive) for all channel widths supported by the VHT STA — HT-mixed format (transmit and receive) — VHT format (transmit and receive) — 20 MHz, 40 MHz, and 80 MHz channel widths — Single spatial stream VHT-MCSs 0 to 7 (transmit and receive) in all supported channel widths — Binary convolutional coding <p>A VHT STA may support the following features:</p> <ul style="list-style-type: none"> — HT-greenfield format (transmit and receive) — 2 or more spatial streams (transmit and receive) — 400 ns short guard interval (transmit and receive) — Beamforming sounding (by sending a VHT NDP) — Responding to transmit beamforming sounding (by providing compressed beamforming feedback) — STBC (transmit and receive) — LDPC (transmit and receive) — VHT MU PPDU (transmit and receive) — Support for 160 MHz channel width — Support for 80+80 MHz channel width — VHT-MCSs 8 and 9 (transmit and receive) <p>Source: IEEE 802.11-2016 at 2497.</p> <p>There is one more additional first mode and second mode with bandwidth expansion that uses spatial multiplexing within IEEE 802.11-2016, which is the Television Very High Throughput (TVHT) mode.</p>

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>22. Television very high throughput (TVHT) PHY specification</p> <p>22.1 Introduction</p> <p>22.1.1 Introduction to the TVHT PHY</p> <p>Clause 22 specifies the PHY entity for a television very high throughput (TVHT) orthogonal frequency division multiplexing (OFDM) system.</p> <p>Three basic channel units (BCUs) are defined as 6 MHz, 7 MHz, or 8 MHz, depending on the regulatory domain, and denoted in the rest of this clause as a BCU or TVHT_W. Many of the terms used in this clause refer to different bands, depending on the regulatory domain. These terms include</p> <ul style="list-style-type: none"> — TVHT_2W, which represents two contiguous BCUs (12 MHz, 14 MHz, or 16 MHz) — TVHT_W+W, which represents two noncontiguous BCU (6+6 MHz, 7+7 MHz, or 8+8 MHz) — TVHT_4W, which represents four contiguous BCUs (24 MHz, 28 MHz, or 32 MHz) — TVHT_2W+2W, which represents two noncontiguous frequency segments, each of which is composed of two BCUs (12+12 MHz, 14+14 MHz, or 16+16 MHz) <p>A TVHT STA may support the following features:</p> <ul style="list-style-type: none"> — TVHT_MODE_2C, TVHT_MODE_2N, TVHT_MODE_4C, or TVHT_MODE_4N (two or four BCUs) — Two or more spatial streams (transmit and receive) — Beamforming sounding (by sending a VHT NDP frame) — Respond to transmit beamforming sounding (provide compressed beamforming feedback) — STBC (transmit and receive) — LDPC (transmit and receive) — VHT MU PPDU (transmit and receive) — MCSs 8 and 9 (transmit and receive) <p>Source: IEEE 802.11-2016 at 2625-2626.</p>

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Claim 1	Example American Count V Systems and Services
<p>[1.a] in the first mode based on spatial multiplexing: generating separate first mode transmit symbols by first transmitters of the transceiver and second transmitters of the transceiver; and transmitting the separate first mode transmit symbols from the first transmitters and the second transmitters over a first set of antennas and a second set of antennas across a spectrum of frequencies that is same for each of the first transmitters and the second transmitters; and</p>	<p>On information and belief, the American Count V Systems and Services, in the first mode based on spatial multiplexing: generating separate first mode transmit symbols by first transmitters of the transceiver and second transmitters of the transceiver; and transmitting the separate first mode transmit symbols from the first transmitters and the second transmitters over a first set of antennas and a second set of antennas across a spectrum of frequencies that is same for each of the first transmitters and the second transmitters.</p> <p>IEEE 802.11n and 802.11ac both support spatial multiplexing, a MIMO technique that increases throughput by transmitting multiple independent spatial streams simultaneously over the same frequency channel. While 20 and 40 MHz channels in 802.11n and 40, 80, 160 MHz (including 80+80 MHz) in 802.11ac provide wider bandwidths for data transmission, spatial multiplexing specifically refers to the use of multiple spatial streams, not just wider channels or additional transmit chains. These spatial streams are mapped to sets of transmit antennas and transmitted concurrently, enabling higher data rates.</p>

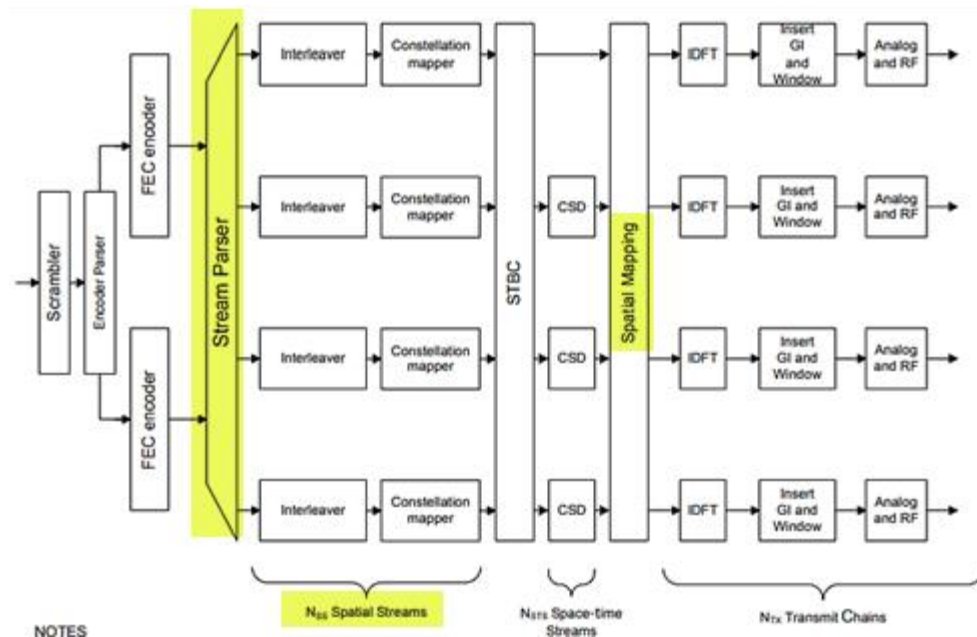
U.S. Patent No. 10,103,845 (Claim 1)

Claim 1

Example American Count V Systems and Services

19.3.4 Overview of the PPDU encoding process

- o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH_BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of
- p) Map each of the complex numbers in each of the N_{ST} subcarriers in each of the OFDM symbols in each of the N_{STS} space-time streams to the N_{TX} transmit chain inputs. For direct-mapped operation,



Source: IEEE 802.11-2016 at 2350, 2351, 2353.

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Claim 1

Example American Count V Systems and Services

Table 21-2—Interpretation of FORMAT, NON_HT_MODULATION, CH_BANDWIDTH, and CH_OFFSET parameters

FORMAT	NON_HT_MODULATION	CH_BANDWIDTH	CH_OFFSET	PPDU format
VHT	N/A	CBW20	N/A	The STA transmits a VHT PPDU (when FORMAT is VHT) of 20 MHz bandwidth. If the BSS bandwidth is wider than 20 MHz, then the transmission shall use the primary 20 MHz channel.
VHT	N/A	CBW40	N/A	The STA transmits a VHT PPDU (when FORMAT is VHT) of 40 MHz bandwidth. If the BSS bandwidth is wider than 40 MHz, then the transmission shall use the primary 40 MHz channel.

Source: IEEE 802.11-2016 at 2508.

19.3.3 Transmitter block diagram

- d) *Stream parser* divides the outputs of the encoders into blocks that are sent to different interleaver and mapping devices. The sequence of the bits sent to an interleaver is called a *spatial stream*.
- h) *Spatial mapper* maps space-time streams to transmit chains. This may include one of the following:

Source: IEEE 802.11-2016 at 2349, 2350.

The IEEE 802.11n standard uses Multiple-Input Multiple-Output (MIMO) technology to support high data rates up to 600Mbps. It uses multiple transmit and receive RF chains to support two modes of operation. *Spatial Diversity* transmits a single data stream from each chain, thus leveraging independent fading over multiple links to enhance signal diversity. *Spatial Multiplexing* (SM) transmits independent and separately encoded spatial streams from the multiple chains to boost throughput. The performance gains of MIMO are achieved at the cost of increased power consumption due to the added complexity of MIMO related processing and circuits.

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Claim 1

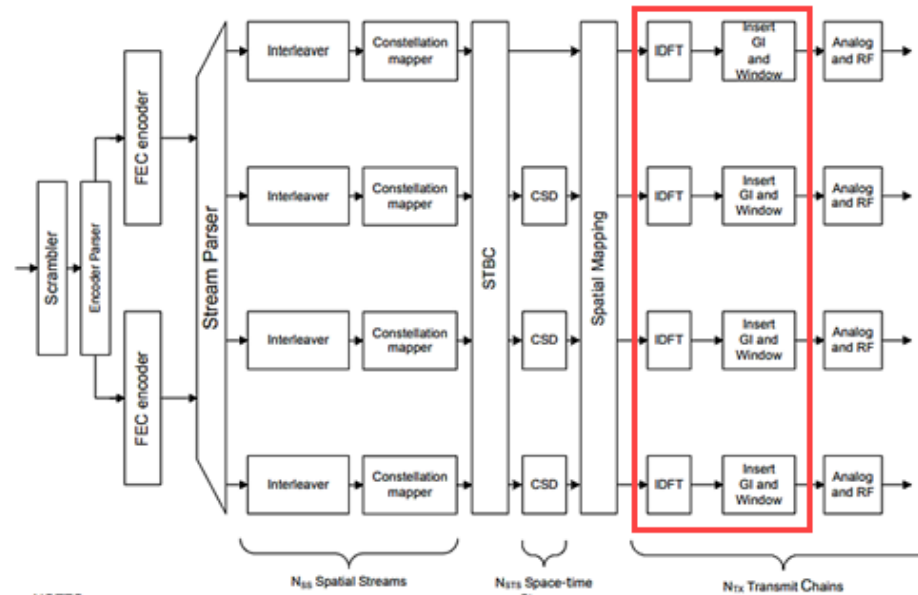
Example American Count V Systems and Services

Source: I. Pefkianakis et al., "What is wrong/right with IEEE 802.11n Spatial Multiplexing Power Save feature?," 2011 19th IEEE International Conference on Network Protocols, Vancouver, BC, at 186-195.

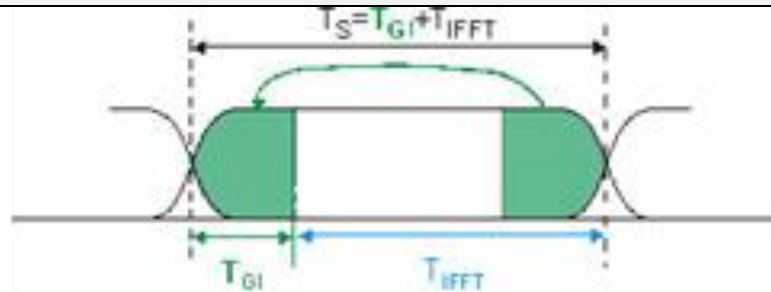
OFDM symbols are generated using an IDFT processing step and a Guard Interval insertion.

19.3.4 Overview of the PPDU encoding process

- r) For each group of N_{ST} subcarriers and each of the N_{TX} transmit chains, convert the subcarriers to time domain using IDFT. Prepend to the Fourier-transformed waveform a circular extension of itself, thus forming a GI, and truncate the resulting periodic waveform to a single OFDM symbol length by applying time domain windowing. Determine the length of the GI according to the GI_TYPE parameter of the TXVECTOR. Refer to 19.3.11.11 and 19.3.11.12 for details. When beamforming is not used, it is sometimes possible to implement the cyclic shifts in the time domain.



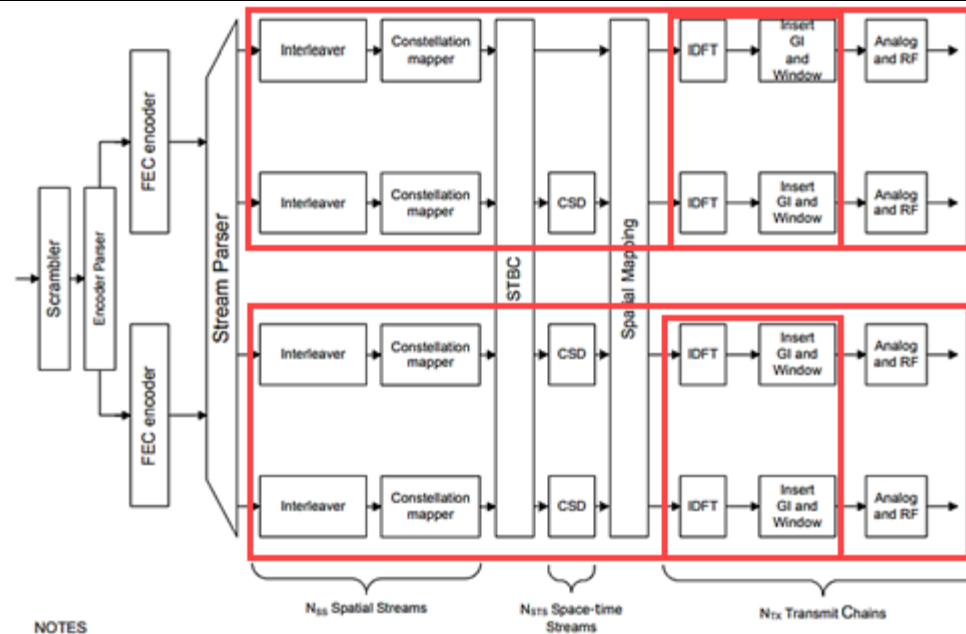
Source: IEEE 802.11-2016 at 2349, 2350, 2353.

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	 <p>Typical OFDM Frame with cyclic extension</p> <p>Source: http://rfmw.em.keysight.com/wireless/helpfiles/89600b/webhelp/Subsystems/wlan-mimo/content/mimo_fmt_grdintparams.htm.</p> <p>In the 20 MHz mode, first and second transmitters create first mode transmit symbols for transmission from different sets of antennas. The first and second transmitters are exemplary.</p> <p>19.3.4 Overview of the PPDU encoding process</p> <p>o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of</p>

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Example American Count V Systems and Services



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Source: IEEE 802.11-2016 at 2350, 2351, 2353.

An HT AP with 20 MHz mode transmits OFDM symbols over a first set of antennas associated with the first transmitter and a second set of antennas associated with the second transmitter. Both transmitters use the same 20 MHz spectrum frequencies.

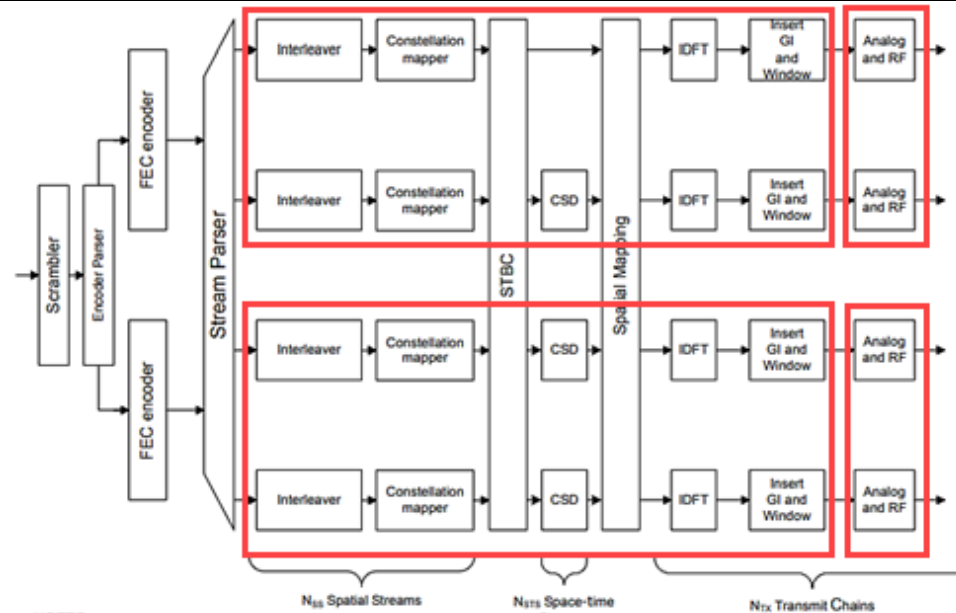
19.3.4 Overview of the PPDU encoding process

- o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of

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Claim 1

Example American Count V Systems and Services



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- t) Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 19.3.7 for details. The transmit chains are connected to antenna elements according to ANTENNA_SET of the TXVECTOR if ASE is applied.

Source: IEEE 802.11-2016 at 2351, 2353, 2354.

For the 802.11-2016 standard, an HT AP can operate in a plurality of modes including 20 MHz, 40 MHz, 80 MHz, 160 MHz, and 80+80 MHz as described in 802.11n and/or 802.11ac. For example, the first mode may include 20 MHz or 40 MHz channel widths.

11.16.2 Basic 20/40 MHz BSS functionality

An HT AP declares its channel width capability (20 MHz only or 20/40 MHz) in the Supported Channel Width Set subfield of the HT Capabilities element.

Source: IEEE 802.11-2016 at 1747.

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>3.2 Definitions specific to IEEE Std 802.11</p> <p>40-MHz-capable (40MC) high-throughput (HT) access point (AP): An HT AP that included a value of 1 in the Supported Channel Width Set subfield (indicating its capability to operate on a 40 MHz channel) of its most recent transmission of a frame containing an HT Capabilities element.</p> <p>Source: IEEE 802.11-2016 at 144.</p> <p>19.3.4 Overview of the PPDU encoding process</p> <p>o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH_BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of non-HT formats), insert four subcarriers as pilots into positions -21, -7, 7, and 21. The total number of the subcarriers, N_{ST}, is 56. For 40 MHz operation (with the exception of MCS 32 and non-HT duplicate format), insert six subcarriers as pilots into positions -53, -25, -11, 11, 25, and 53, resulting in a total of $N_{ST} = 114$ subcarriers. See 19.3.11.11.5 for pilot locations when using MCS 32 and 19.3.11.12 for pilot locations when using non-HT duplicate format. The pilots are modulated using a pseudorandom cover sequence. Refer to 19.3.11.10 for details. For 40 MHz operation, apply a +90° phase shift to the complex value in each OFDM subcarrier with an index greater than 0, as described in 19.3.11.11.4, 19.3.11.11.5, and 19.3.11.12.</p> <p>Source: IEEE 802.11-2016 at 2353.</p> <p>The main PHY features in a VHT STA that are not present in an HT STA are the following:</p> <ul style="list-style-type: none"> — Mandatory support for 40 MHz and 80 MHz channel widths <p>Source: IEEE 802.11-2016 at 197.</p>

A VHT AP operates in 20MHz, 40MHz, and 80MHz channel widths.

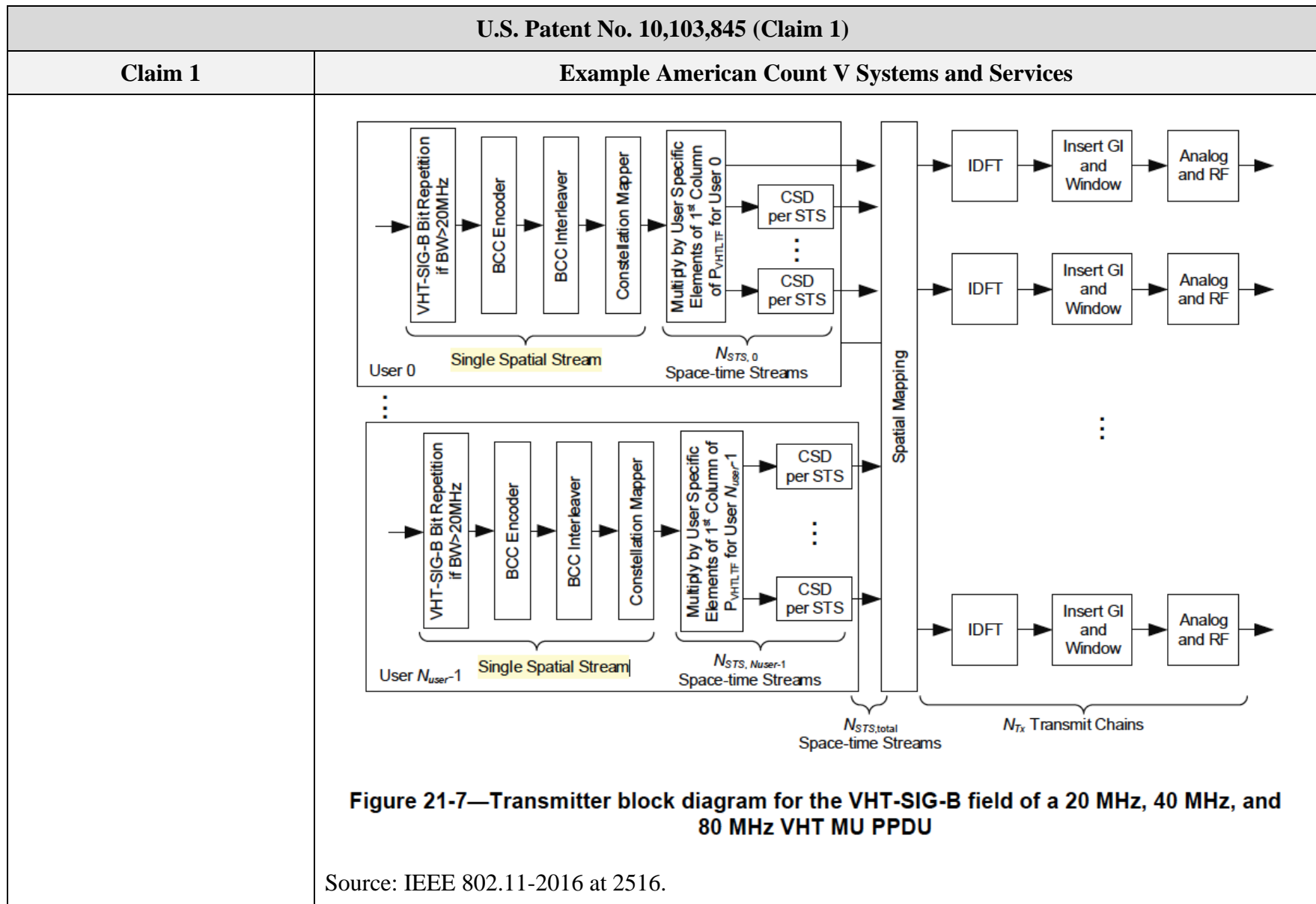
A VHT STA shall support the following features:

- Non-HT and non-HT duplicate formats (transmit and receive) for all channel widths supported by the VHT STA
- HT-mixed format (transmit and receive)
- VHT format (transmit and receive)
- 20 MHz, 40 MHz, and 80 MHz channel widths
- Single spatial stream VHT-MCSs 0 to 7 (transmit and receive) in all supported channel widths
- Binary convolutional coding

A VHT STA may support the following features:

- HT-greenfield format (transmit and receive)
- 2 or more spatial streams (transmit and receive)
- 400 ns short guard interval (transmit and receive)
- Beamforming sounding (by sending a VHT NDP)
- Responding to transmit beamforming sounding (by providing compressed beamforming feedback)
- STBC (transmit and receive)
- LDPC (transmit and receive)
- VHT MU PPDU (transmit and receive)
- Support for 160 MHz channel width
- Support for 80+80 MHz channel width
- VHT-MCSs 8 and 9 (transmit and receive)

Source: IEEE 802.11-2016 at 2497.



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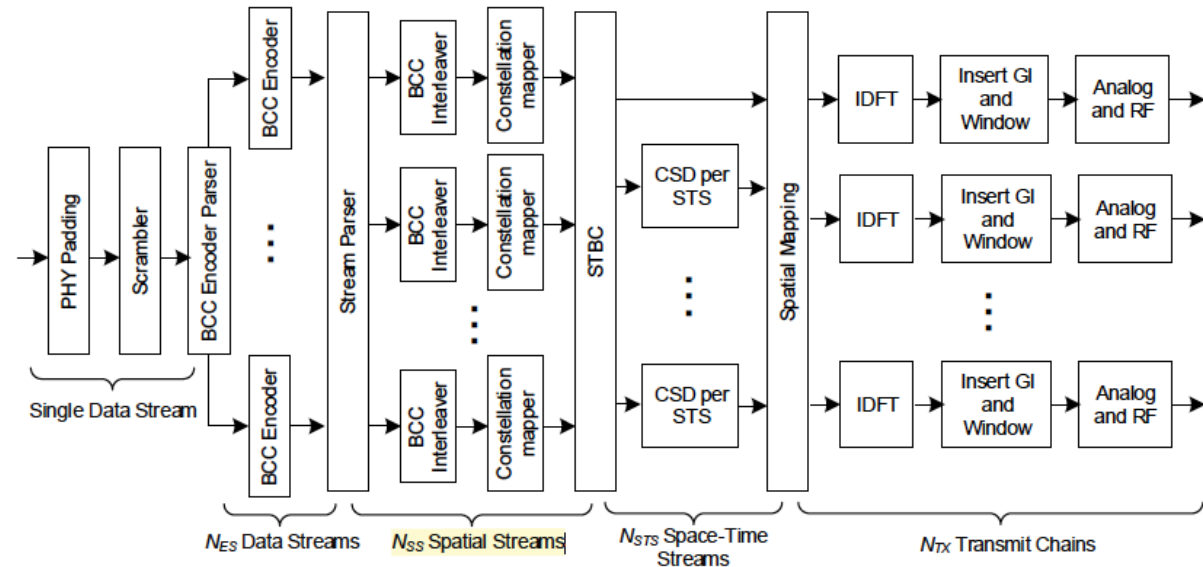


Figure 21-10—Transmitter block diagram for the Data field of a 20 MHz, 40 MHz, or 80 MHz VHT SU PPDU with BCC encoding

Source: IEEE 802.11-2016 at 2518.

21.3.5 VHT modulation and coding scheme (VHT-MCS)

The VHT-MCS is a value that determines the modulation and coding used in the Data field of the PPDU. It is a compact representation that is carried in the VHT-SIG-A field for VHT SU PPDU and in the VHT-SIG-B field for VHT MU PPDU. Rate-dependent parameters for the full set of VHT-MCSs are shown in Table 21-30 to Table 21-61 (in 21.5). These tables give rate-dependent parameters for VHT-MCSs with indices 0 to 9, with number of spatial streams from 1 to 8 and bandwidth options of 20 MHz, 40 MHz,

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>80 MHz, and either 160 MHz or 80+80 MHz. Equal modulation (EQM) is applied to all streams for a particular user.</p> <p>Source: IEEE 802.11-2016 at 2527-2528.</p> <p>The transmit process for generating the TVHT-SIG-B field of a VHT SU PPDU and VHT MU PPDU using one frequency segment is shown in Figure 21-5 and Figure 21-7, respectively, with “TVHT” replacing “VHT” and with bandwidth corrected according to TVHT bandwidth.</p> <p>The transmit process for generating the Data field of a SU PPDU in TVHT_MODE_1, TVHT_MODE_2C, or TVHT_MODE_4C with BCC and LDPC encodings, using one BCU, is shown Figure 21-10 and Figure 21-11, respectively, with “TVHT” replacing “VHT” and with bandwidth corrected according to TVHT bandwidth. Single BCC encoder shall be assumed in Figure 21-10.</p> <p>Source: IEEE 802.11-2016 at 2638.</p> <p>22.3.5 Modulation and coding scheme (MCS)</p> <p>The MCS is a value that determines the modulation and coding used in the Data field of the PPDU. It is a compact representation that is carried in the TVHT-SIG-A field for SU PPDU and in the TVHT-SIG-B field for MU PPDU. Rate-dependent parameters for the full set of MCSs are shown in Table 22-26 to Table 22-37 (in 22.5). These tables give rate-dependent parameters for MCSs with indices 0 to 9, with number of spatial streams from 1 to 4 and bandwidth options of one, two, or four BCUs. Equal modulation (EQM) is applied to all streams for a particular user.</p> <p>Table 22-26 to Table 22-29 show rate-dependent parameters for MCSs for one to four streams for one BCU operation. Table 22-30 to Table 22-33 show rate-dependent parameters for MCSs for one to four streams for dual BCU operation. Table 22-34 to Table 22-37 show rate-dependent parameters for MCSs for one to four streams for quad BCU operation.</p> <p>Source: IEEE 802.11-2016 at 2542-2543.</p>

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Claim 1	Example American Count V Systems and Services
<p>[1.b] in the second mode based on the spatial multiplexing and bandwidth expansion: generating separate second mode transmit symbols by the first transmitters and the second transmitters; transmitting the separate second mode transmit symbols from the first transmitters over the first set of antennas across a first spectrum of frequencies; and transmitting the separate second mode transmit symbols from the second transmitters over the second set of antennas across a second spectrum of frequencies,</p>	<p>On information and belief, the American Count V Systems and Services, in the second mode based on the spatial multiplexing and bandwidth expansion: generating separate second mode transmit symbols by the first transmitters and the second transmitters; transmitting the separate second mode transmit symbols from the first transmitters over the first set of antennas across a first spectrum of frequencies; and transmitting the separate second mode transmit symbols from the second transmitters over the second set of antennas across a second spectrum of frequencies.</p> <p>For example, 20 and 40 MHz modes of operation both use spatial multiplexing technology to map the transmitted data to multiple transmit chains.</p>

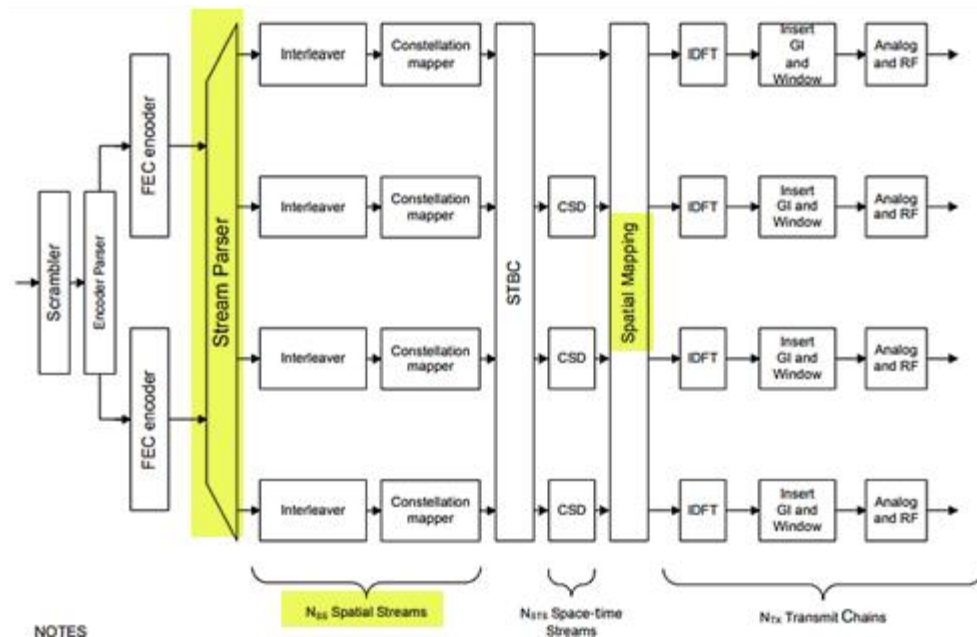
U.S. Patent No. 10,103,845 (Claim 1)

Claim 1

Example American Count V Systems and Services

19.3.4 Overview of the PPDU encoding process

- o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH_BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of
- p) Map each of the complex numbers in each of the N_{ST} subcarriers in each of the OFDM symbols in each of the N_{STS} space-time streams to the N_{TX} transmit chain inputs. For direct-mapped operation,



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Source: IEEE 802.11-2016 at 2350, 2351, 2353.

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Claim 1

Example American Count V Systems and Services

Table 21-2—Interpretation of FORMAT, NON_HT_MODULATION, CH_BANDWIDTH, and CH_OFFSET parameters

FORMAT	NON_HT_MODULATION	CH_BANDWIDTH	CH_OFFSET	PPDU format
VHT	N/A	CBW20	N/A	The STA transmits a VHT PPDU (when FORMAT is VHT) of 20 MHz bandwidth. If the BSS bandwidth is wider than 20 MHz, then the transmission shall use the primary 20 MHz channel.
VHT	N/A	CBW40	N/A	The STA transmits a VHT PPDU (when FORMAT is VHT) of 40 MHz bandwidth. If the BSS bandwidth is wider than 40 MHz, then the transmission shall use the primary 40 MHz channel.

Source: IEEE 802.11-2016 at 2508.

19.3.3 Transmitter block diagram

- d) *Stream parser* divides the outputs of the encoders into blocks that are sent to different interleaver and mapping devices. The sequence of the bits sent to an interleaver is called a *spatial stream*.
- h) *Spatial mapper* maps space-time streams to transmit chains. This may include one of the following:

Source: IEEE 802.11-2016 at 2349, 2350.

In the 40 MHz mode, first and second transmitters create first mode transmit symbols for transmission from different sets of antennas. The first and second transmitters are exemplary.

19.3.4 Overview of the PPDU encoding process

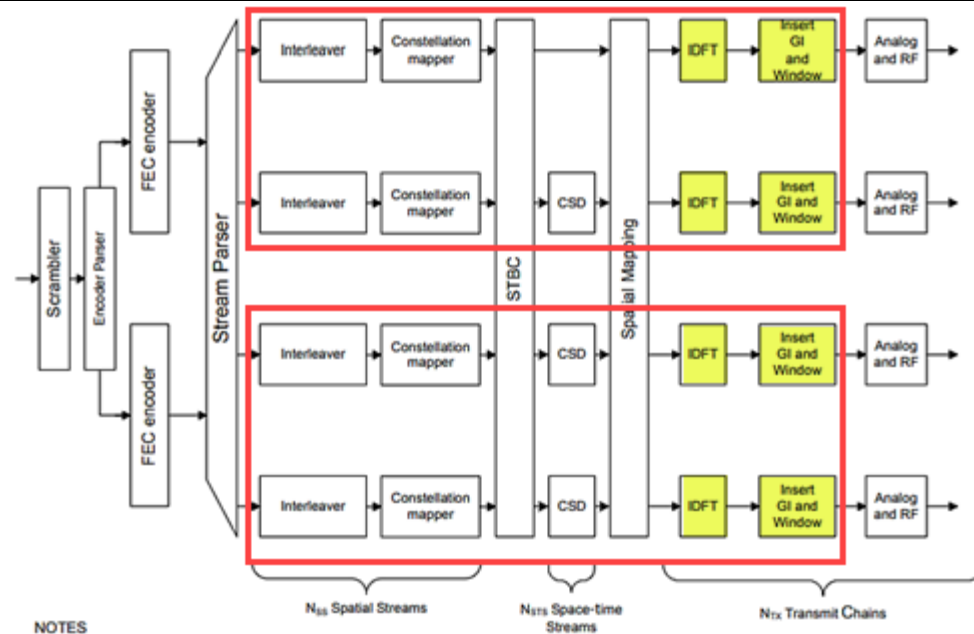
- o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH_BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of

Source: IEEE 802.11-2016 at 2353.

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Example American Count V Systems and Services



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Source: IEEE 802.11-2016 at 2350.

All operating modes use OFDM to transmit the data. For 20 MHz bandwidth signals, Legacy Mode uses 48 data subcarriers and 4 pilot subcarriers, while HT modes use 52 data subcarriers and 4 pilot subcarriers. This gives 20 MHz HT mode slightly more throughput than Legacy Mode. For 40 MHz bandwidth signals, there are 108 data subcarriers and 6 pilot subcarriers. This gives 40 MHz HT mode more than twice the throughput of 20 MHz HT mode.

Source: http://rfmw.em.keysight.com/wireless/helpfiles/89600b/webhelp/subsystems/wlan-mimo/Content/mimo_80211n_overview.htm.

An HT AP with 40 MHz mode transmits the OFDM subcarriers over a first set of antennas associated with first transmit chains across a primary 20 MHz channel.

40 MHz Channels

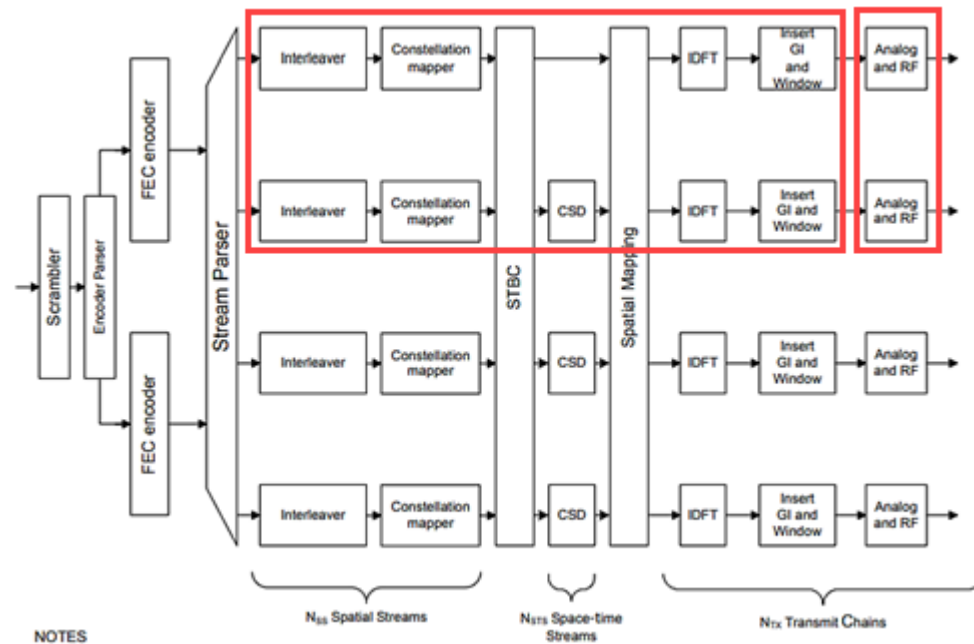
The 40 MHz channels used by HT radios are essentially two 20 MHz OFDM channels that are bonded together. Each 40 MHz channel consists of a primary and secondary 20 MHz channel. The primary and secondary 20 MHz channels must be adjacent 20 MHz

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Example American Count V Systems and Services

Source: D. Westcott et al., "CWAP Certified Wireless Analysis Professional Official Study Guide: Exam PW0-270," Wiley, 2011 at 364.



NOTES

Source: IEEE 802.11-2016 at 2350.

- t) Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 19.3.7 for details. The transmit chains are connected to antenna elements according to ANTENNA_SET of the TXVECTOR if ASEL is applied.

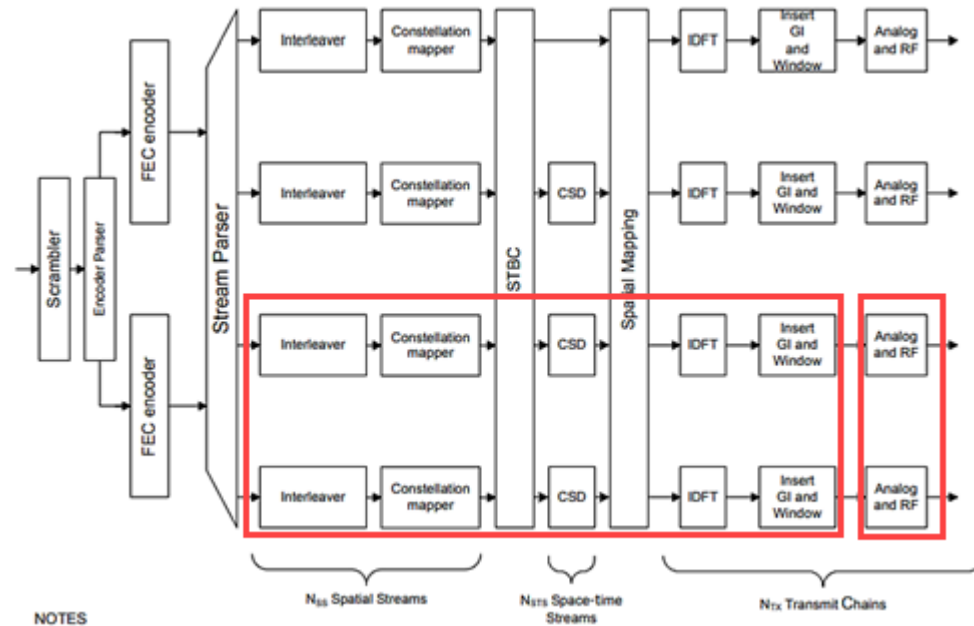
Source: IEEE 802.11-2016 at 2351, 2353, 2354.

An HT AP with 40 MHz mode transmits the OFDM symbols over a second set of antennas associated with second transmit chains across a secondary 20 MHz channel.

40 MHz Channels

The 40 MHz channels used by HT radios are essentially two 20 MHz OFDM channels that are bonded together. Each 40 MHz channel consists of a primary and secondary 20 MHz channel. The primary and secondary 20 MHz channels must be adjacent 20 MHz

Source: D. Westcott et al., "CWAP Certified Wireless Analysis Professional Official Study Guide: Exam PW0-270," Wiley, 2011 at 364.



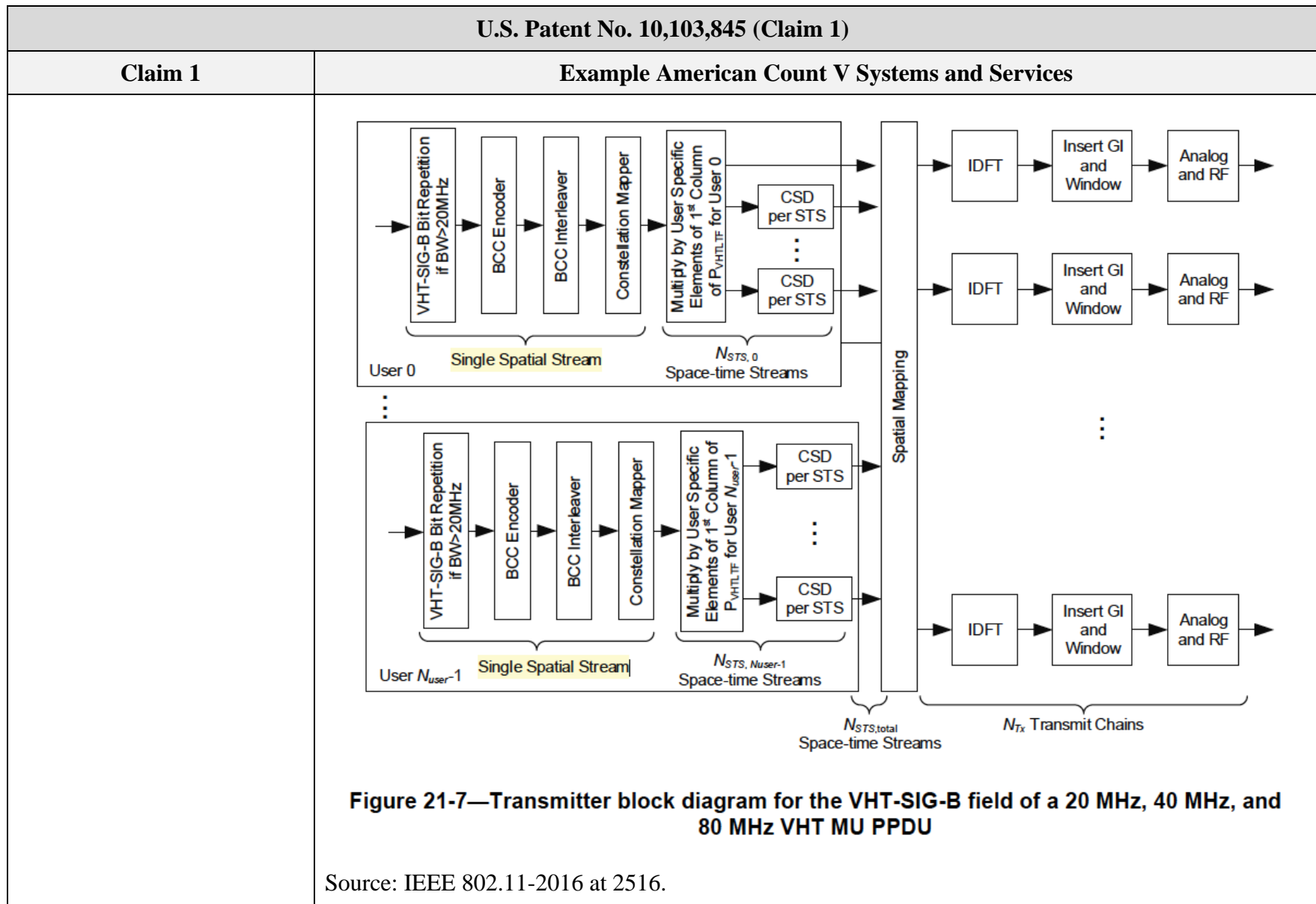
Source: IEEE 802.11-2016 at 2350.

- t) Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 19.3.7 for details. The transmit chains are connected to antenna elements according to ANTENNA_SET of the TXVECTOR if ASE is applied.

Source: IEEE 802.11-2016 at 2351, 2353, 2354.

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>For the 802.11-2016 standard, an HT AP can operate in a plurality of modes including 20 MHz, 40 MHz, and 80 MHz as described in 802.11n and/or 802.11ac. The second mode may include 40 MHz or 80 MHz channel widths. VHT AP modes leverage spatial multiplexing with up to 8 spatial streams, where spatial multiplexing occurs when multiple independent data streams are simultaneously transmitted.</p> <p>11.16.2 Basic 20/40 MHz BSS functionality</p> <p>An HT AP declares its channel width capability (20 MHz only or 20/40 MHz) in the Supported Channel Width Set subfield of the HT Capabilities element.</p> <p>Source: IEEE 802.11-2016 at 1747.</p> <p>3.2 Definitions specific to IEEE Std 802.11</p> <p>40-MHz-capable (40MC) high-throughput (HT) access point (AP): An HT AP that included a value of 1 in the Supported Channel Width Set subfield (indicating its capability to operate on a 40 MHz channel) of its most recent transmission of a frame containing an HT Capabilities element.</p> <p>Source: IEEE 802.11-2016 at 144.</p> <p>19.3.4 Overview of the PPDU encoding process</p> <p>o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH_BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of non-HT formats), insert four subcarriers as pilots into positions -21, -7, 7, and 21. The total number of the subcarriers, N_{ST}, is 56. For 40 MHz operation (with the exception of MCS 32 and non-HT duplicate format), insert six subcarriers as pilots into positions -53, -25, -11, 11, 25, and 53, resulting in a total of $N_{ST} = 114$ subcarriers. See 19.3.11.11.5 for pilot locations when using MCS 32 and 19.3.11.12 for pilot locations when using non-HT duplicate format. The pilots are modulated using a pseudorandom cover sequence. Refer to 19.3.11.10 for details. For 40 MHz operation, apply a +90° phase shift to the complex value in each OFDM subcarrier with an index greater than 0, as described in 19.3.11.11.4, 19.3.11.11.5, and 19.3.11.12.</p> <p>Source: IEEE 802.11-2016 at 2353.</p>

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>The main PHY features in a VHT STA that are not present in an HT STA are the following:</p> <ul style="list-style-type: none"> — Mandatory support for 40 MHz and 80 MHz channel widths <p>Source: IEEE 802.11-2016 at 197.</p> <p>A VHT STA shall support the following features:</p> <ul style="list-style-type: none"> — Non-HT and non-HT duplicate formats (transmit and receive) for all channel widths supported by the VHT STA — HT-mixed format (transmit and receive) — VHT format (transmit and receive) — 20 MHz, 40 MHz, and 80 MHz channel widths — Single spatial stream VHT-MCSs 0 to 7 (transmit and receive) in all supported channel widths — Binary convolutional coding <p>A VHT STA may support the following features:</p> <ul style="list-style-type: none"> — HT-greenfield format (transmit and receive) — 2 or more spatial streams (transmit and receive) — 400 ns short guard interval (transmit and receive) — Beamforming sounding (by sending a VHT NDP) — Responding to transmit beamforming sounding (by providing compressed beamforming feedback) — STBC (transmit and receive) — LDPC (transmit and receive) — VHT MU PPDU (transmit and receive) — Support for 160 MHz channel width — Support for 80+80 MHz channel width — VHT-MCSs 8 and 9 (transmit and receive) <p>Source: IEEE 802.11-2016 at 2497.</p>



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Claim 1

Example American Count V Systems and Services

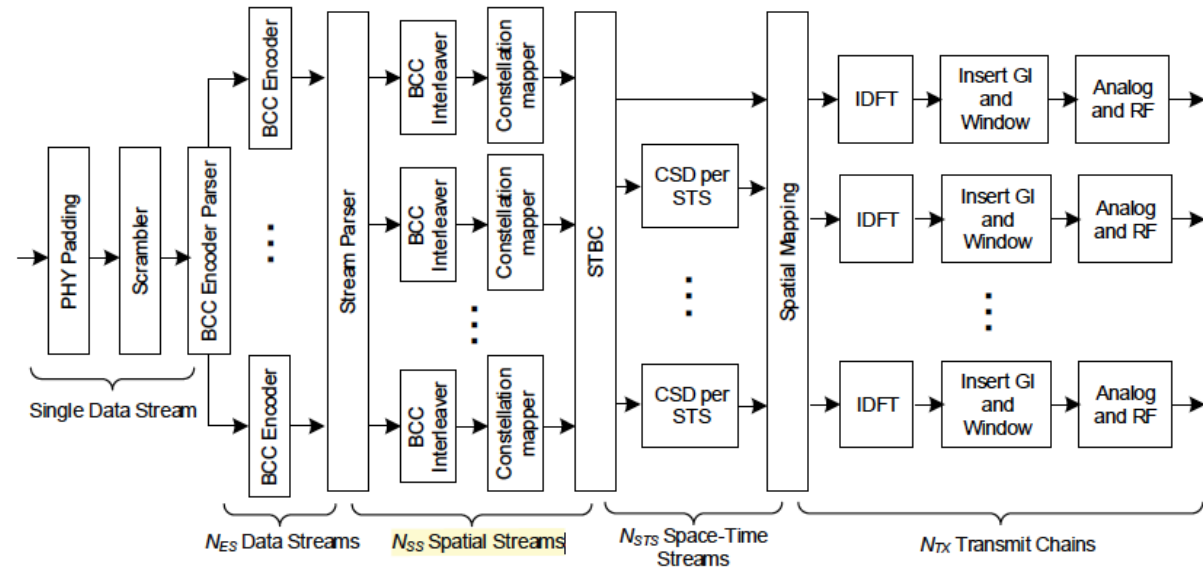


Figure 21-10—Transmitter block diagram for the Data field of a 20 MHz, 40 MHz, or 80 MHz VHT SU PPDU with BCC encoding

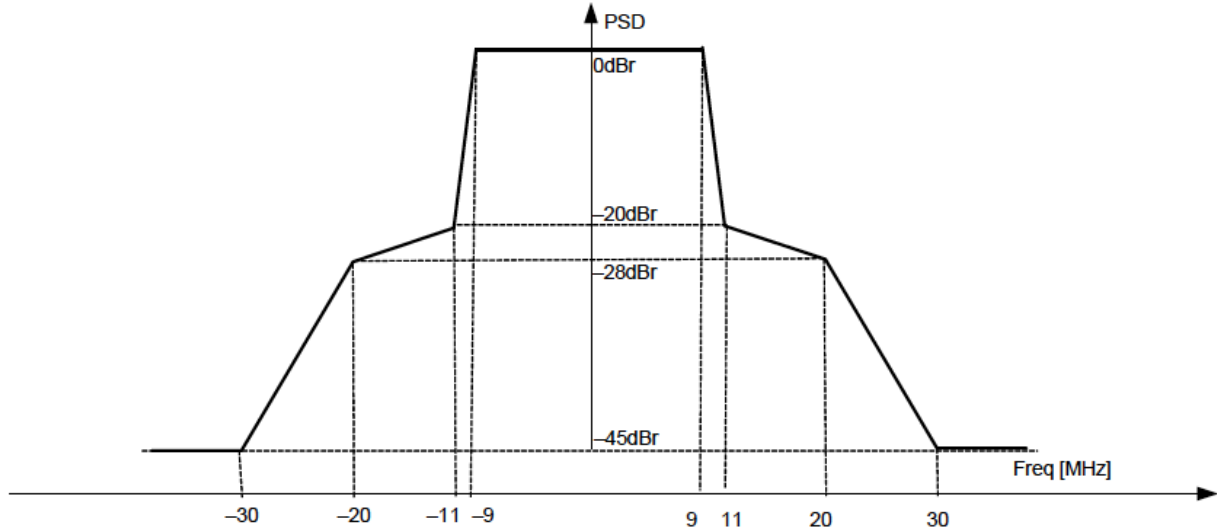
Source: IEEE 802.11-2016 at 2518.

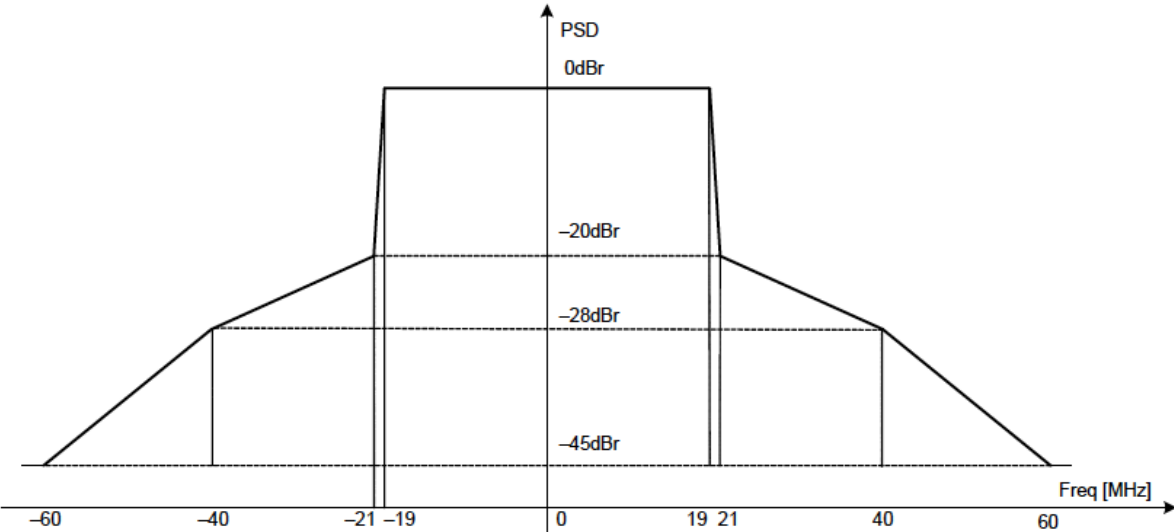
21.3.5 VHT modulation and coding scheme (VHT-MCS)

The VHT-MCS is a value that determines the modulation and coding used in the Data field of the PPDU. It is a compact representation that is carried in the VHT-SIG-A field for VHT SU PPDU and in the VHT-SIG-B field for VHT MU PPDU. Rate-dependent parameters for the full set of VHT-MCSs are shown in Table 21-30 to Table 21-61 (in 21.5). These tables give rate-dependent parameters for VHT-MCSs with indices 0 to 9, with number of spatial streams from 1 to 8 and bandwidth options of 20 MHz, 40 MHz,

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>80 MHz, and either 160 MHz or 80+80 MHz. Equal modulation (EQM) is applied to all streams for a particular user.</p> <p>Source: IEEE 802.11-2016 at 2527-2528.</p> <p>The transmit process for generating the TVHT-SIG-B field of a VHT SU PPDU and VHT MU PPDU using one frequency segment is shown in Figure 21-5 and Figure 21-7, respectively, with “TVHT” replacing “VHT” and with bandwidth corrected according to TVHT bandwidth.</p> <p>The transmit process for generating the Data field of a SU PPDU in TVHT_MODE_1, TVHT_MODE_2C, or TVHT_MODE_4C with BCC and LDPC encodings, using one BCU, is shown Figure 21-10 and Figure 21-11, respectively, with “TVHT” replacing “VHT” and with bandwidth corrected according to TVHT bandwidth. Single BCC encoder shall be assumed in Figure 21-10.</p> <p>Source: IEEE 802.11-2016 at 2638.</p> <p>22.3.5 Modulation and coding scheme (MCS)</p> <p>The MCS is a value that determines the modulation and coding used in the Data field of the PPDU. It is a compact representation that is carried in the TVHT-SIG-A field for SU PPDU and in the TVHT-SIG-B field for MU PPDU. Rate-dependent parameters for the full set of MCSs are shown in Table 22-26 to Table 22-37 (in 22.5). These tables give rate-dependent parameters for MCSs with indices 0 to 9, with number of spatial streams from 1 to 4 and bandwidth options of one, two, or four BCUs. Equal modulation (EQM) is applied to all streams for a particular user.</p> <p>Table 22-26 to Table 22-29 show rate-dependent parameters for MCSs for one to four streams for one BCU operation. Table 22-30 to Table 22-33 show rate-dependent parameters for MCSs for one to four streams for dual BCU operation. Table 22-34 to Table 22-37 show rate-dependent parameters for MCSs for one to four streams for quad BCU operation.</p> <p>Source: IEEE 802.11-2016 at 2542-2543.</p>

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
[1.c] wherein the first spectrum of frequencies does not overlap with the second spectrum of frequencies.	<p>On information and belief, the American Count V Systems and Services practice claim limitations [1.a] and [1.b], where the first spectrum of frequencies does not overlap with the second spectrum of frequencies.</p> <p>For example, in 40 MHz channel mode primary and secondary are non-overlapping. Note that HT uses the word “adjacent” to describe two contiguous 20 MHz channels. HT does not support non-contiguous (as seen below with VHT), hence it only uses the word “adjacent”.</p> <p>In the case of the MCS 32 and non-HT duplicate formats, the same data are transmitted over two adjacent 20 MHz channels. In this case, the 40 MHz channel is divided into 128 subcarriers, and the data are transmitted on subcarriers –58 to –6 and 6 to 58.</p> <p>Source: IEEE 802.11-2016 at 2356.</p>

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>For the 2.4 GHz band, when transmitting in a 20 MHz channel, the transmitted spectrum shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth not exceeding 18 MHz, -20 dBr at 11 MHz frequency offset, -28 dBr at 20 MHz frequency offset, and the maximum of -45 dBr and -53 dBm/MHz at 30 MHz frequency offset and above. The transmitted spectral density of the transmitted signal shall fall within the spectral mask, as shown in Figure 19-17. The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.</p>  <p>Figure 19-17—Transmit spectral mask for 20 MHz transmission in the 2.4 GHz band</p> <p>Source: IEEE 802.11-2016 at 2404.</p>

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>For the 2.4 GHz band, when transmitting in a 40 MHz channel, the transmitted spectrum shall have a 0 dBr bandwidth not exceeding 38 MHz, -20 dBr at 21 MHz frequency offset, -28 dBr at 40 MHz offset, and the maximum of -45 dBr and -56 dBm/MHz at 60 MHz frequency offset and above. The transmitted spectral density of the transmitted signal shall fall within the spectral mask, as shown in Figure 19-18.</p>  <p>Figure 19-18—Transmit spectral mask for a 40 MHz channel in the 2.4 GHz band</p> <p>Source: IEEE 802.11-2016 at 2405.</p> <p>40 MHz Channels</p> <p>The 40 MHz channels used by HT radios are essentially two 20 MHz OFDM channels that are bonded together. Each 40 MHz channel consists of a primary and secondary 20 MHz channel. The primary and secondary 20 MHz channels must be adjacent 20 MHz channels for the frequencies across which they operate. As pictured in Figure 10.7, the two 20 MHz channels used to form a 40 MHz channel are designated as primary and second-</p>

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>Source: D. Westcott et al., “CWAP Certified Wireless Analysis Professional Official Study Guide: Exam PW0-270,” Wiley, 2011 at 364.</p> <p>VHT mode can operate over contiguous or non-contiguous spectrum of frequencies, either of which are non-overlapping.</p> <p>The VHT PHY provides support for 20 MHz, 40 MHz, 80 MHz, and 160 MHz contiguous channel widths and support for 80+80 MHz noncontiguous channel width.</p> <p>Source: IEEE 802.11-2016 at 2497.</p>

U.S. Patent No. 10,103,845 (Claim 1)

Claim 1

Example American Count V Systems and Services

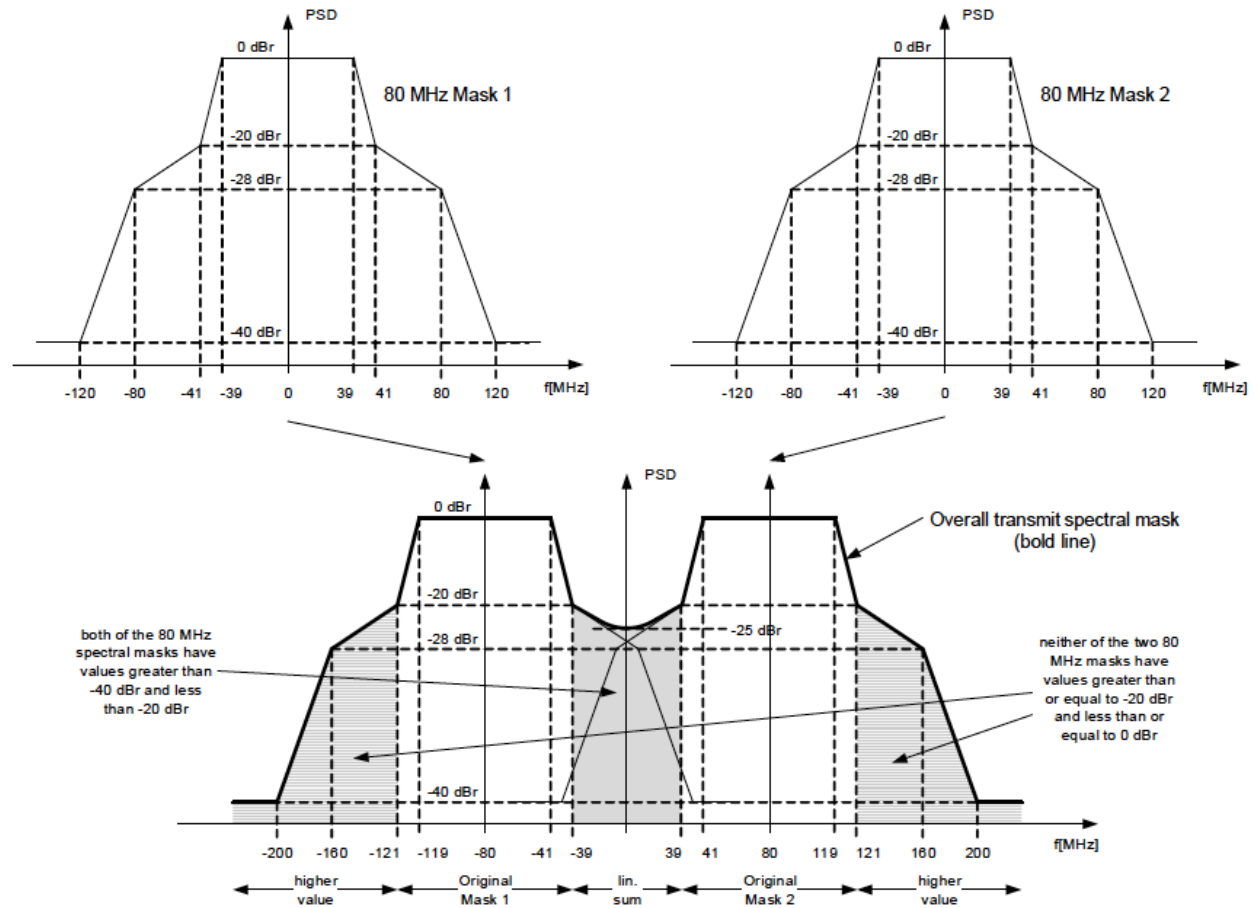


Figure 21-33—Example transmit spectral mask for 80+80 MHz mask PPDU

U.S. Patent No. 10,103,845 (Claim 1)	
Claim 1	Example American Count V Systems and Services
	<p>11.4 Channel access in wider channels</p> <p>With the 802.11n amendment, channel widths up to 40 MHz are supported. With the 802.11ac amendment, channel widths of up to 160 MHz are supported. In the 5 GHz band, these wider channels (40 MHz, 80 MHz, 160 MHz, or 80+80 MHz) are formed by combining 20 MHz sub-channels in a non-overlapping manner (see Figure 11.1).</p> <p>Source: E. Perhia et al., “Next Generation Wireless LANs: 802.11n and 802.11ac,” (2d. Ed. 2013) at 301.</p> <p>Similarly, TVHT can operate over contiguous or non-contiguous spectrum of frequencies, either of which are non-overlapping.</p> <p>Three basic channel units (BCUs) are defined as 6 MHz, 7 MHz, or 8 MHz, depending on the regulatory domain, and denoted in the rest of this clause as a BCU or TVHT_W. Many of the terms used in this clause refer to different bands, depending on the regulatory domain. These terms include</p> <ul style="list-style-type: none"> — TVHT_2W, which represents two contiguous BCUs (12 MHz, 14 MHz, or 16 MHz) — TVHT_W+W, which represents two noncontiguous BCU (6+6 MHz, 7+7 MHz, or 8+8 MHz) — TVHT_4W, which represents four contiguous BCUs (24 MHz, 28 MHz, or 32 MHz) — TVHT_2W+2W, which represents two noncontiguous frequency segments, each of which is composed of two BCUs (12+12 MHz, 14+14 MHz, or 16+16 MHz) <p>Source: IEEE 802.11-2016 at 2625.</p>

U.S. Patent No. 10,103,845 (Claim 1)

Claim 1

Example American Count V Systems and Services

Example transmit spectral mask for a TVHT_W+W mask PPDU for BCU of 6 MHz and spacing of 12 MHz is shown in Figure 22-4.

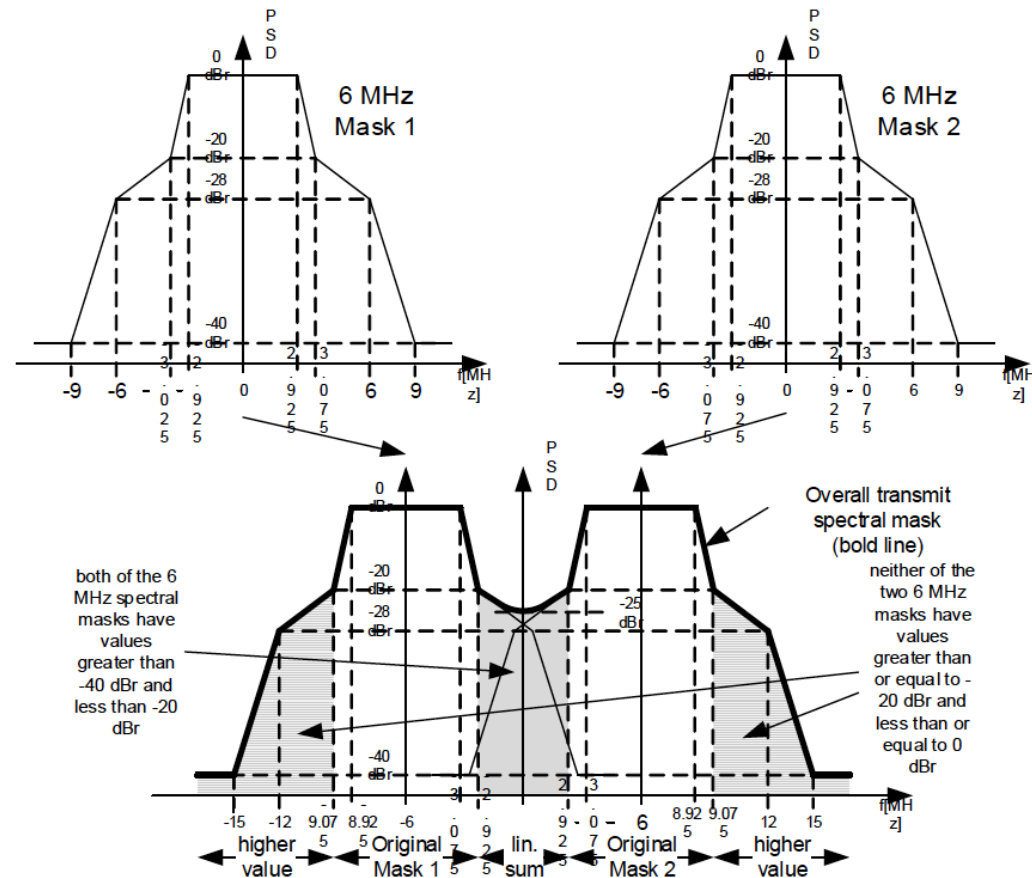


Figure 22-4—Example transmit spectral mask for an 6+6 MHz mask PPDU

Source: IEEE 802.11-2016 at 2658.